SCIENCE

ol. 97 — Friday, April 23, 1943 — No. 2521

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

SCIENCE, SCIENTISTS AND SOCIETY[1]

By Professor M. G. MELLON

DEPARTMENT OF CHEMISTRY, PURDUE UNIVERSITY

The subject selected for this address—"Science, Scientists and Society"—is indeed formidable, at least to any group assembled for an occasion such as this. On the one hand, the range is nearly limitless; and, on the other hand, time and the ability of the speaker are definitely limited. Then, too, triteness is a handicap, for often equivalent subjects must have served many a commencement speaker needing a non-committal title for his remarks.

Nevertheless, the choice was made deliberately, since previous addresses by chemists before this academy have all been very general in nature. Formulas and equations, the chemist's indispensable form of sign-writing, have been almost entirely avoided. In following this precedent it seemed wise to reject as possible subjects various aspects of analytical chemistry, my principal field of research. In a more positive direction, the choice was made because of a feeling that what is most fundamental in science for a chemist is equally fundamental for other scientists. Whatever interest the discussion may have, therefore, should be general.

The Problem

Many years of teaching and research have aroused a personal desire to know, as far as possible, the essence of the scientific activity to which most of us are devoting our lives. Just what is science? Is it a kind of religion, sufficient in itself as a way of life in modern society? If all were trained in science, would we be able to live together happily thereafter? Possibly what I have in mind may be clearer in the form of another question—What does science mean to me? Obviously, the answer to be proposed is entirely personal. My only justification for presuming to present it is the

[1] Address presented by the retiring president of the Indiana Academy of Science at the fall meeting, October 30, 1942.

hope that each of you, if you have not already done so, will make a similar effort to answer the question yourself. Like John Dewey, most of us must feel some urge to pursue such a quest for certainty. One's answer reflects his attitude as a scientist.

These broad aspects and implications of science seem to have little interest for the average scientist and technologist. Busy with their respective activities, these people transmit tradition, pigeon-hole facts, theorize about them, and apply them in a thousand ways. Although the total effect of these activities during the last two centuries has been profound, both on our daily lives and on our thinking, only occasionally have writers tried to evaluate the really basic contributions of science and scientists to society and to focus their possibilities on the future.

Such evaluations as have been made range from high praise to disparagement. The former is represented by the predictions of A. H. Compton and of J. D. Bernal that science can remake the world, and by the assertion of W. B. Pitkin that scientists are the only ones to-day who have anything worth saying. For the latter we may mention the book, "Science the False Messiah," by C. E. Ayres, and the statement of Vice-President Henry A. Wallace that science, during the last hundred years, has merely increased the speed of life without increasing its quality.

President R. M. Hutchins, of the University of Chicago, a prominent student of educational trends, has questioned the basic contributions of science to society. Excerpts from his addresses are quoted.

> The sciences at best may help us to attain our ends if we knew what those ends were; . . . but we do not know where we are going or why, and we have almost given up the attempt to find out. We are in despair because the keys which were to open the gates of heaven have let us into a larger but more oppressive prison house. We think those keys were science and the free intelligence of men. They have failed us. Many have long since cast off God. To what end can we now appeal? The answer comes in the undiluted animalism of D. H. Lawrence, in the emotionalism of demagogues, in Hitler's scream, "We think with our blood." . . .
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> The centrifugal forces released through the dissolution of ultimate beliefs have split the universities into a thousand fragments. These institutions, instead of leading us through the modern world, mirror its confusion. . . . We are in the midst of a great moral, intellectual and spiritual crisis. To pass it successfully or to build the world after it is over, we shall have to get clear about those ends and ideals which are the first principles of human life and of organized society. Our people should be able to look to the universities for the moral courage, the intellectual clarity, and the spiritual elevation needed to guide and uphold them in this critical hour. . . . Research is not enough either to hold the university together or to give direction to bewildered humanity. We must now seek not knowledge, but wisdom.

In re-examining science for its essence there is this year, as never before, more than satisfaction of mere curiosity to be considered. Involvement in another world war, threatening our very civilization, makes especially urgent the question of what permanent help we may expect from science. We need occasionally to transcend our specialties to gain a balanced perspective of just what science is, and is not, in contemporary life.

Most scientists would probably agree that science represents primarily an extension of knowledge. Presumably such accumulated information is expected to accrue to the benefit of mankind, for people have long been told that the truth would make them free. Thus, in theory at least, it would seem that science should serve society in some constructive way.

By itself, and through innumerable practical applications, science has been, in fact, of untold benefit to us. We know more about the material universe, and we are better able to control it, than any preceding generation. All this is, or could be for the general good. Such information and activity are potentially constructive in helping us to meet the ceaseless succession of events constituting the cosmological drama. That knowledge is power has become a proverb of the race. The scientist and technologist appeared in the scene only recently; but so significant have been the results that we often hear the present period referred to as the age of science.

Unfortunately, science, especially in its applications, does not necessarily contribute to the general welfare. As a result, many individuals have been, and some still are, critical of our work. Lavoisier, the greatest chemist of the eighteenth century, was beheaded with the curt comment that France had no need for scientists. Recently holidays for research have been advocated, presumably in the hope of reducing technological unemployment thereby. The year 1942 finds us in the midst of the most devastating war in history, one whose unparalleled destruction is possible only because of scientific knowledge.

We are faced, then, with a great paradox of constructive versus destructive possibilities and actualities. I shall attempt to examine the relation of science and scientists to human affairs in the hope that an orientation of our perspective may aid in making dominant the constructive potentialities of science. Also we shall note what science does not, and probably can not, do. In the time available it will be possible to indicate only in broad outline what seem to be the most important aspects of this problem.

Science and Its Accomplishments

Science may be defined as knowledge which has been systematized with reference to the discovery of general truths or the operation of general laws. The

process of assembling, organizing and applying this knowledge has long been under way. For centuries the rate of progress was very slow; but in recent decades it has been so accelerated that to-day the civilized world is relatively aware of the larger subdivisions of science, such as biology, chemistry, geology and physics.

For the present purpose our interest is not in the minutiae of any of these subjects. What seem important are the items that may be considered as a kind of scientific common denominator. Long contemplation of what these are has led to the conclusion that all science, theoretical and applied, can be reduced to two categories—facts and their interpretations. It will now be necessary to examine each of these categories more at length. Subsequently, attention will be directed to the procedure of science, the scientific method, including its motivation and application.

I. *Facts.* Science begins with facts and facts form its body. These units of funded experience and knowledge are its basic truths.

A. S. Eddington refers to facts as being often primarily meter readings. Yet we must have many of them, for they are the basis of understanding and of intelligent action in the physical world. For example, the uninformed might eat cyanide, but only once, of course. Constituting the principal portion of the descriptive material in sciences such as biology, chemistry and geology, facts represent observational records. In addition, they serve as the foundation of all applied science. Through invention they yield new machines, processes, compositions of matter and biological plants.

Incidentally, in spite of their obvious importance, facts may be overemphasized in teaching. We instructors may be largely responsible for the development in certain students of a near-allergy for the sciences. These subjects, instead of being a thrilling intellectual awakening to such students, mean chiefly the memorization of endless bare facts, to be parrotted back to the instructor and then promptly forgotten. As stated by a novelist, the subject is treated as "a corpse which bit by bit we painfully dissect."

Facts should be definite and unquestionable. Also it is highly desirable to have them demonstrable in order to make later verification possible in case of doubt. Indeed, some consider that in science a fact must be mechanically demonstrable to be true.

There are, however, many conflicts over facts, for scientific observation is often subject to illusion and error. Thus most people state that the sun rises in the east and sets in the west, although it does neither. Frequently facts are difficult to obtain, and there may be disagreement as to what they are. One needs only to mention such problems as prohibition of alcoholic liquors, the economic depression of 1932 or one's chances for immortality without baptismal immersion to illustrate the confusion that may prevail. For these troublesome cases Glenn Frank advised that "all the remedies for all the types of conflicts are alike in that they begin by finding the facts rather than by starting a fight."

"The recording of facts," according to the late Justice O. W. Holmes, "is one of the tasks of science, one of the steps toward truth; but it is not the whole of science. There are one-story intellects, two-story intellects and three-story intellects with sky lights. All fact collectors, who have no aim beyond their facts, are one-story men."

Mere collections of facts do not make science, any more than a pile of stones makes a house. The facts must be systematized, according to suitable criteria, to constitute scientific knowledge. This classification process is really only an extension of the description process of fact collecting.

Chemistry presents two striking examples of classification. The compounds of carbon are arranged in the monumental treatise of Beilstein according to classes. The 4,877 types projected about the year 1900 have been found adequate for the third of a million organic compounds now known. The compounds of the other 91 chemical elements are discussed in inorganic treatises primarily according to families, as found in Mendeleef's famous periodic table. Without such organization, the countless facts covered in either case would be largely useless.

Finally, it should be noted that facts, in and of themselves, do not move us to do anything with them. For instance, how many, even among scientists, act on the basis of the known facts of genetics when they select the parent of their prospective children? Neither more facts, nor wider dissemination of those we already possess, will alone be sufficient to improve society.

II. *Interpretation of Facts.* The poet Noyes visualized the next step in his statement, "Day after day the slow sure records grow, awaiting their interpreters." Such are the multi-story men of Justice Holmes. "Two-story men," said he, "compare, reason, and generalize, using the labors of the fact collectors as well as their own. Three-story men idealize, imagine, and predict. Their best illumination comes from above, through the sky light."

Interpretation of facts consists, then, of finding relationships and formulating generalizations. The facts are the basis for conclusions, reached by induction. One may distinguish between the process followed and the products obtained.

(1) *The Process.* The first step in any interpretation is to study the facts, both individually and collectively. After they are subjected to scrutiny from all feasible viewpoints, possible or probable conclu-

sions are proposed. Finally, we formulate our tentative generalizations or plans of action.

Many would maintain that this operation consists in explaining the facts. We should note, however, that one does not explain phenomena in any final sense. Science merely locates things and their actions in space and time. It does not indicate what finally makes them act or why they are.

According to H. Poincaré, the mathematician, science can not teach us the nature of things—only their relations. Science "explains" a phenomenon, the effect, by showing that it is a necessary, or probable, consequence of another phenomenon, the cause. As R. W. Emerson said, "the effect already blooms in the cause." Over-zealous teachers, in asking for explanations of phenomena, run the risk of developing in their students an unjustified feeling of finality in this respect. At best, with Shakespeare's soothsayer, one can state, "In Nature's infinite book of secrecy a little can I read."

If we have difficulty agreeing upon the facts which bear on a given problem, it is little wonder that different people may interpret a given set of facts differently. The development of science has seen the rise and fall of many an interpretation. One of the most famous examples in chemistry was the phlogiston theory of combustion, advocated for more than a century by all the famous chemists of the time but now recognized as a totally erroneous concept.

(2) *The Products.* The results of generalization, whenever the process is carried far enough, may be recognized in one of three forms. These are so well known that they need little more than mention here.

An hypothesis is the least definite of the interpretations. It is not much more than a tentative assumption regarding possible cause-effect relations, an intelligent guess about the how of things.

A theory may be considered as a more or less matured hypothesis. It has advanced far enough toward certainty to be subject to experimental verification. It must be open to modification as long as experiments do not support the necessary conclusions. A theory is the working plan of projected experiments, such as the enterprise of the Tennessee Valley Authority.

A law is a generalized statement of the order or relation of phenomena. A law of nature explains nothing, of course, for it is only a descriptive formula which states what things do. In it isolated fact-descriptions are given a generalized description form. Even then few laws are more than approximations, for they generally rest upon statistical probability.

III. *The Scientific Method.* Our vast stock of facts, and of interpretations in the form of theories and laws, combined with myriad technological applications based upon them, represent a truly remarkable achievement of the human race. The material contributions of the last two centuries far exceed all similar prior progress. Such extensive accomplishments merit consideration of their cause.

Many factors must have been operative; but probably it would be conceded that objective experimentation and impartial thinking, more than anything else, are responsible. In fact, A. N. Whitehead has stated that "the greatest invention of the nineteenth century was the invention of the method of invention." In the words of E. C. Wickenden, "progress no longer waits on genius or the occasional lucky thought—instead we have learned to put our faith in the organized efforts of ordinary men." Our great industrial research laboratories are striking evidence of this faith.

This process, which has proved so fruitful, is known as the scientific method. Briefly, it involves collecting the facts, sorting or classifying them, formulating conclusions therefrom, and, if possible, subjecting these to experimental verification. Publication of the results usually follows with academic scientists. Perhaps the most succinct statement of the process ever made is that of Glenn Frank, a non-scientist. In his words, "our concern with the facts is to (1) find them, (2) filter them, (3) focus them and (4) face them."

In discussing progress in his book, "The Mind in the Making," J. H. Robinson outlined four principal types of thinking. (1) We day-dream—an activity to be observed among one's students, or possibly one's colleagues. (2) We make routine decisions—often a necessary activity; for example, one has to select items at a cafeteria counter. (3) We defend our prejudices—an activity in which we really begin to show some zest, especially if the subject in question is economic, political, religious, or social, and if we have been suitably conditioned in early life. How much time and energy have been wasted here. (4) We think creatively—an activity Professor Robinson ranked low in quantity. Its quality, however, is about the only hope the race has for material progress. The great performers in this category are Holmes's three-story men—the Newtons, the Darwins and the Einsteins.

With scientists this creative thinking involves the scientific method. Its effectiveness depends upon obtaining the facts without resort to authority and upon reasoning with an unprejudiced mind. The most important result of science teaching, according to scientists, would be achievement of this self-elimination in forming judgments. The significance of this attitude of mind can not be over-emphasized. Probably the basic test of a scientist is his sincerity toward the scientific method.

The extent of our factual knowledge, and of its technical applications, would seem to be ample evidence of the worth of this method. Nearly every science teacher extols its merits, and he would vigorously affirm that his first teaching objective is to inculcate his students with this process of thinking, to be used not only in the specific subject studied but also in everyday problems. To illustrate its industrial effectiveness he may point to the fact that chemical research laboratories of the United States have produced more than 200,000 products since 1914.

Limitations of Science and Scientists

With this record of achievement, represented by an immeasurable extension and application of knowledge, using a process of proven worth, who could be dissatisfied? Yet thoughtful individuals have expressed disappointment in the total results. Thus, according to Vice-President Wallace, himself a scientist, the last century of science has not improved the quality of society, although science yields annually an ever greater stream of truth.

The present state of society and the attitude of men toward each other, after two centuries of contact with modern science, make one wonder. Is there any basis for adverse criticism? If weakness exists, can anything be done about it? Or have we simply been misled to expect too much?

Since the scientific method has been so effective in obtaining truth about the physical world, many have assumed that knowledge of this effectiveness insures application of the process, at least by scientists and those trained in science, to focus this truth on our daily problems. If one is shown the way, it is only reasonable to assume that he will follow it. Such complacency, however, is destined for disillusionment. Once again, the process consists in finding, filtering, focusing and facing the facts. Obviously, this is merely a logical sequence of actions. What is lacking is motivation for action. There is nothing inherent in the method either to make one want to get the truth or to act upon it if and when obtained. How many chemists, for example, to say nothing of the thousands who have studied chemistry incidentally, try to live according to the best knowledge of physiological chemistry? We know well enough the way to normal weight and to sobriety; but the fat and the alcoholic continue wih us. We need, as Glenn Frank stated, a fifth step—following the facts. Even this would not provide the initial urge to get them.

H. G. Deming, a chemist, must have sensed this limitation when he wrote:

> science is but a feeble means for motivating life. It enlightens men, but fails to arouse them to deeds of self-sacrifice and devotion. . . . It dispels ignorance, but it never launched a crusade. It gives aid in the struggle with the hard surroundings of life, but it does not inform us to what end we struggle, or whether the struggle is worth while. . . . Intelligence can do little more than direct.

This lack of motivation in the scientific method, combined with the mental inertia of the ordinary habit-laden individual and the emotional inertness of facts, undoubtedly accounts largely for what we find on surveying the adoption of the process by scientists for general use and by the educated public.

Most reputable scientists are likely to conform to the method reasonably well in their specialties, particularly if the work is to be published. It is well known, however, that even eminent men may show little more than the prejudices established by early conditioning when they presume to discuss topics outside their own specialties. In fact, it is not common to find scientists who can be generally trusted for scientific soundness of judgment on non-scientific subjects. Winning a famous scientific prize or holding an important position give no assurance that the individual's opinions on economic, political, religious or social questions have any considered factual basis. This abandonment of the scientific method by many scientists, when they close the door of their laboratory, reminds one of the pseudo-religionist who goes to church on Sunday and then grabs all he can on Monday. A man's veneer of scientific attitude must be thick to prevent his thus easily reverting to the prejudices of youth.

The so-called educated public gives us even less reason for optimism. President N. M. Butler, of Columbia University, has stated the case in an annual report, from which quotation is made:

> For two generations, a very considerable part, perhaps a major part, of the effort of educational systems and institutions has been expended upon the development of teaching and research in the natural and experimental sciences. . . . The essential fact in all scientific study is the use and the comprehension of the scientific method. Every conclusion as it is reached is held subject to verification, modification or overthrow by later inquiry or by the discovery of new methods and processes of research. . . .
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> One would suppose that after half a century of this experience and this discipline the popular mind would bear some traces of the influence of the scientific method, and that it would be guided by that method, at least in part, in reaching results and in formulating policies in social and political life. If there be any evidence of such effort, it is certainly not easy to find. Passion, prejudice, unreason still sway men precisely as if scientific method had never been heard of. How is it possible, with all the enormous advances of science and with all its literally stupendous achievements, that it has produced such negligible results on the mass temperament and the mass mind?

This is a question that may well give us pause, for something must be lacking if intelligent men and women, long brought into contact with scientific method and scientific processes, pay no attention whatever to these and show no effect of their influence, when making private or public judgments.

If we teachers are producing only partially scientific scientists, and almost entirely non-scientific laymen, what is the reason? Probably foremost is our own incomplete exemplification of the scientific attitude. We can hope to justify the method to others only as we believe in and practice it generally ourselves, irrespective of the possible personal rewards or costs. To the extent that expediency makes us disloyal to this ideal, we foster the cynical, widespread suspicion that every man has his price. It is hardly necessary, of course, to note that attempting to be scientific in everyday life and to follow one's conclusions may take courage and be costly, as more than one scientist can testify. Stuart Chase has analyzed this problem most effectively in an article entitled "The Luxury of Integrity."

Although more truly scientific teachers and leaders would help, another fundamental obstacle is our current conception of success. We are motivated, with too few exceptions, by dollars and things rather than by ideals of understanding and of humanitarian service. For measuring accomplishment the popular standard is income in industry and number of publications in college teaching. Thus despoilers of the nation's natural resources are likely to be honored as great business men, if they become rich, while the discoverer of a fundamental law of nature may go hungry. "If there is a fatal weakness in American society," writes A. H. Compton, "it is the lack of (enduring) objective." But, undaunted by this idolatry of the material, Lewis Mumford, new head of Leland Stanford's School of Humanities, still thinks the ultimate problem of a university is one of values rather than publications and patents.

Consideration of this diverse motivation, ranging from the idealistic to the materialistic, may help us to understand something of the social actions of scientists and of the technologists who use science.

Those directing their efforts toward idealistic goals are attempting first of all to understand the facts, as far as possible. Individuals with curiosity long to learn about man and his world. How does the firefly produce his light? What causes the succession of the seasons? Why do some people have red hair or in later life have left on their head little of any hue? These and a thousand like questions crowd the mind of any one alert to his physical environment. The thinking man has the capacity and likes to understand things.

To achieve the highest good, this individual attempts not only to understand the facts, but also, in the light of them, to make that adjustment to his physical environment, including his fellow men, which will promote the general welfare. To him knowledge of nature results both in admiration for its laws and in an effort to conform to them. A famous chemist, Justus Liebig, recognizing the ideality possible in this direction, stated that science to such individuals is a goddess to worship.

Although few people would object to a better understanding of facts, evidently what is most often sought of science is facts to use, whether they are understood or not. Control of their environment, by means of applied science, seems to be the goal of the majority of scientists and users of science. Thus the chemist makes synthetics, the metallurgist alloys, the physicist radioactive atoms and the geneticist new plants.

To what purpose is all the latter activity directed? Why are our research and development laboratories, numbering more than two thousand in the United States alone, spending many millions of dollars annually to get new facts and make new products? Primarily the urge is to survive or to gain personal or group advantage. The individual strives to make some discovery, usually in order to reap financial or other personal reward, rather than to improve the lot of humanity. The great corporation aims to keep in advance of competitors; real competition spurs ingenuity, discovery and invention. Something of the extent of such activity is revealed by the announcement each Tuesday of approximately a thousand new United States patents.

Liebig must have felt this materiality when he completed his statement about science by noting that to many individuals it is merely a cow to milk. Among the milkers one finds the whole collection of self-seekers, the most offensive of whom use science chiefly as a means for accomplishing their selfish objectives. Here, unfortunately, are the acquisitive, the egotistic, the expedient, the insincere, the dictatorial, the ruthless and the dishonest—in short, the little Hitlers of science. To this group may be traced most of the distrust and discord so often found among academic and industrial scientists. What a change in personal relationships, and consequently in science, would result if these people were to practice the Golden Rule.

Viewed from the standpoint of the possibility of improving society, these limitations may be summarized as (1) emotional inertness of science, (2) lack of motivation in the scientific method and (3) low social consciousness of the majority of those trained in science. As for the first two, we must resign ourselves to the inevitable—they are facts. Any hope of improvement, therefore, must center in the human

element. A. A. Berle, Assistant Secretary of State, used these words: "The techniques of modern life—our engineering, chemistry, and medicine . . . are only tools. In and of themselves they do nothing; what they achieve arises from the desires of men's minds."

The Future of Science

What of the future? In such troubled times as these prophecy is extraordinarily uncertain, for no one can foretell the results of the social and political forces now loose. Science might become restricted to implementing the repressive tyranny of those in power. In suggesting other possibilities, we are assuming that no such fate awaits it.

With the return of reasonable sanity and stability in social and political life, it seems safe to predict that science will continue in the general direction taken during the last few decades. More facts will be discovered, technological applications, perhaps undreamed of to-day, will be found for many of them, and new theories and laws will be formulated. The scientific method will work in the future, as it has in the past, in the physical and biological sciences.

But need this be all? Some scientists, at least, do not think so. Since science has revealed so much about things, from coal tar to the stars, and since it has shown how to operate, these men think that economic, political and social problems are susceptible to such treatment. Indicative of this trend is the formation of the Committee on Science and Society of the American Association for the Advancement of Science. Recently its chairman, L. K. Frank, wrote, "if we are to have a social order directed by intelligence and guided by scientific knowledge, . . . scientists must take a more active role in focusing scientific study and in helping to direct the application of their findings." In similar vein, G. H. Boyd has stated, "the task of implanting the aim, the spirit, and the method of science in the minds and the activities of the public is one of the important tasks which science and industry must face."

Much as the social order seems to need such attention, it is not clear that the men quoted realize the limitations of science. It provides means and a method; but there is little probability, judging by the past, that science alone can ever make men more socially minded. Such motivation must originate in ways beyond the scope of this address. According to C. E. Ayres, "science is completely impotent to determine what had better happen. . . . The only attitude toward human struggles appropriate to modern science is serene indifference, the indifference of the dynamo or the mechanical calculator."

In considering what lies ahead, therefore, account must be taken of human possibilities and aspirations. The scientific method undoubtedly can be applied in areas now little touched, even though the process may be more difficult than in the physical sciences. Also there is certainly no reason why it can not be followed more consistently by all scientists outside their specialties, and by those whose education has included an introduction to science. The question is whether they want to do it, and whether they are able as individuals to surmount the type of educational conditioning which causes a scientist to react in ways illustrated by his voting a straight political ticket because his grandfather did.

In an ever-changing world man constantly confronts problems. Current examples are the physically and mentally unfit, distribution of wealth, conservation of natural resources and war. Although we could well use many specific contributions, such as a disease-resistant chestnut tree or a cure for cancer, the larger problems are more pressing. There is needed a long-time program based on collective, planned action rather than rugged individualism. The latter alternative is admirable in theory, to the extent that one practicing it may develop much latent ability; but general adherence to this principle would bring results such as unrestricted reproduction of the mentally defective, waste and destruction of natural resources and general practice of might makes right. Application of science and the scientific method, actuated by adequate social motivation, seems a much more promising approach.

Assuming that scientists of the future become motivated to do something, and that they have the opportunity, how would they attack a problem? The following steps seem obvious: (1) get the facts bearing upon it; (2) study it in the light of these facts; (3) choose the tentative solution which seems likely to work best; and (4) make tests to determine if this prospective solution does work. If it does not, modify the method or select another and try again; that is, resort to the pragmatic test of workability by following the Biblical admonition to "Prove all things and hold fast to that which is good."

Some famous scientists, advocating such practice, have expressed the belief that the presence of more of their number in, or close to, economic and political life would greatly facilitate the alleviation of our economic and social problems. In accordance with the Platonian vision of a society led by reliably informed rulers, the suggestion is to have a non-political, permanent, group of investigators to provide information for administrators on possible and desirable courses of action. Such boards, if sincere and socially motivated, could provide information and programs; but for success of the plan the administrators would still have to want, and dare, to apply the knowledge in order to achieve what E. Stanley Jones has called a welfare economy.

The London *Times*, in reporting a conference on science and world order, stated recently, "But though science shows the way, it would be presumptuous to believe that science alone can lead us to the goal. The men of science themselves have moved far since the era of uncritical optimism, when progress was regarded as automatic and science as its predestined instrument. We need no evidence to-day that science can serve evil ends as well as good. . . . This is no reproach to the instrument, but a reminder that the ultimate test of its value lies in the moral purpose directing it. The most important service rendered by the conference has been to bring to public knowledge the almost unlimited potentialities of human development and human well-being which science has to offer. Science provides the opportunity. There must be the will to use it."

CONCLUSION

What, then, does science mean to me? The answer includes elements of admiration, disillusionment and faith.

In essence, science represents an unbelievably large collection of facts and interpretations of these facts, relating to every known area of the natural world. Acquisition of this information and application of it in the arts and industry are the glory of the scientific method.

Science and the scientific method are primarily human tools. They provide information and means for action; but they do not suffice in themselves to make any one act or, in case of action, to direct it to human good. The latter ends, if we want them, necessitate transformation and direction of our motivation by other means.

The scientific approach is the most effective procedure thus far discovered for enabling us to understand, and to adjust ourselves to, the physical world. In doing this we may well turn to Glenn Frank for our motto. "Let's stop being radicals or conservatives," he said, "and be scientists. That is, let's act in the light of the facts in the case, rather than in the (twi)light of our prejudices or the faded labels of our class, our clique, or our clan."

OBITUARY

EDGAR ALLEN

PROFESSOR EDGAR ALLEN, chairman of the Department of Anatomy of Yale University School of Medicine, one of the best-known anatomists and an outstanding authority on the physiology of sex and reproduction, died on February 3. His contagious enthusiasm and energy and his stimulating personality will be missed not only by his associates at Yale but by many throughout the country. His capacity to appreciate the new and significant, his impatience with inactivity and his friendly yet constructive criticism were familiar to all who knew him.

Less than fifty-one years ago Professor Allen was born at Canyon City, Colo., on May 2, 1892. Shortly after his birth the Allen family moved to Providence, R. I., and it was there that, during his youth, he acquired a love of sailing and knowledge of the winds and currents of the Narragansett Bay and Long Island Sound that persisted throughout his life.

Immediately after completing his undergraduate study at Brown University in 1915 he began his graduate studies in biology. During his college and graduate years he contributed largely to his own support by working as student assistant, as a waiter or at other tasks. These experiences undoubtedly contributed, in later years, to the sympathetic understanding and actual assistance he afforded so many students when they were confronted by financial difficulties.

His graduate study was interrupted in May, 1917, when he volunteered for service in World War I as a member of the Brown Ambulance Unit. Later he transferred to a mobile unit of the Sanitary Corps, in which he served in France. By the time he returned to civilian life in February, 1919, he had been commissioned a second lieutenant.

During the summer of 1919 he was an investigator for the U. S. Bureau of Fisheries in laboratories at Woods Hole, Mass. That fall, however, although he had not completed his graduate studies, he became instructor and associate in anatomy at Washington University School of Medicine in St. Louis. During the following two years he completed the requirements for the degree of Doctor of Philosophy from Brown University. In 1923 he became professor of anatomy and chairman of the department of anatomy of the University of Missouri, and later he became, in addition, assistant dean, acting dean and, in 1930, dean of the School of Medicine. In 1933 he again returned to New England as professor of anatomy and chairman of the department of anatomy of Yale University School of Medicine.

Professor Allen's first interest in research pertained to the problem of ovigenesis. At a time when it was generally assumed that the female mammal was born with a full quota of ova he demonstrated that ova could and did arise after birth and even during sexual maturity. While undertaking these, now classical

studies, he was struck by the relation between growth and secretory phenomena in the vaginas and uteri and the development of the ovarian follicles. Further studies revealed that growth and regression of the follicles were associated with all the superficial manifestations of the estrous cycles. Not satisfied with a mere morphological correlation between the development of the follicles and growth of genital tissues Professor Allen, in collaboration with his friend in biochemistry, Dr. E. A. Doisy, successfully demonstrated an active estrus-producing substance in cell-free liquor folliculi of large follicles and in lipoid soluble extracts of the liquor. They were the first to demonstrate convincingly the existence of an active ovarian hormone in the absence of living ovarian tissues.

Shortly after the discovery of the "ovarian" follicular hormone Professor Allen became chairman of the department of anatomy at the University of Missouri. During the next several years he continued experiments on the biological activities, distribution and some chemical characteristics of the "primary ovarian hormone" in collaboration with Dr. Doisy. In addition, in spite of his increased teaching and administrative responsibilities, he undertook experiments on the action of the ovarian hormones in primates. He observed that hormonal factors modifying the accessory genital tissues during the monkeys' menstrual cycles are fundamentally comparable to those regulating the estrous cycles of the rodents. Uterine hemorrhage followed the cessation of adequate ovarian hormonal treatment or the ablation of the ovaries when performed at the proper time.

His early convictions that the ovum is "the dynamic center of the follicle" persisted throughout his life; he left two partially completed manuscripts dealing in part with such studies. This interest in ova undoubtedly prompted his collaboration with Dr. J. P. Pratt at Henry Ford Hospital in Detroit. They obtained the first living human ova from the uterine tubes of women operated upon at appropriate times during the menstrual cycle. They also undertook the first clinical experiments with the "ovarian follicular hormone."

The growth-stimulating action of estrogens on the genital tissues undoubtedly led Professor Allen to study their action on neoplastic growths and upon carcinogenesis. At Yale he fostered enthusiastically many investigations on the influence of steroid hormones upon carcinogenesis. He was especially interested in the influence of estrogens on the malignant transformation of the uterine cervix. His interest in the growth-stimulating capacity of the ovarian hormones was further indicated by the use of the mitosis-accentuating drug, colchicine, in studies on the genital tissues.

During the brief span of twenty-two years Professor Allen contributed over 140 publications of original investigations. In addition he edited and also contributed to the first edition of the book "Sex and Internal Secretions." The editorship of the second and larger edition was shared with two former associates at St. Louis, Dr. E. A. Doisy and Dr. C. H. Danforth. The number of researches he undertook personally was small compared to the many which could be attributed directly to the encouragement and enthusiasm he inspired among his students, graduate students and associates. He was more than generous in bestowing credit for the success of investigations upon his associates.

Honorary doctor of science degrees were conferred upon him by Brown University in 1935 and by Washington University in 1942. He was to receive an honorary doctor of laws from the University of Missouri this spring. In 1937 he was awarded the Legion of Honor in Paris where he was guest of the Singer-Polignac Foundation at a colloquy on the "Sexual Hormones." In 1941 he was honored by the Royal College of Physicians of London when they conferred upon him the Baly Medal for researches on the female sex hormones. At that time it was so appropriately stated that "his contributions to the subject form an essential foundation to modern knowledge of the endocrine action of the ovaries."

He was a member of the American Association of Anatomists, American Association for the Advancement of Science, American Society of Zoologists, Association for the Study of Internal Secretions, American Association for Cancer Research and other scientific organizations. He always enjoyed the meetings of these groups; here he had an opportunity to greet older friends and to meet new ones. Many young investigators will always remember the encouragement his friendly and stimulating comments imparted. During 1941–1942 he served as president of the Association for the Study of Internal Secretions and at the time of his death was president of the "Anatomists."

Professor Allen volunteered for service in the Coast Guard Auxiliary after the present war began. The "Skipper's" many sailing experiences had familiarized him with the irregular segment of Connecticut's coast line which his crew patrolled one day and night each week. When death struck he was on patrol duty with a unit of the flotilla in which he served as junior commander and operations officer.

W. U. Gardner

RECENT DEATHS

WILLIAM MERRILL ESTEN, emeritus professor of bacteriology of the University of Connecticut, died on April 16 at the age of eighty years.

DR. LUTHER SHERMAN ROSS, from 1892 to 1934 professor of biology at Drake University, died on April 5 at the age of seventy-eight years.

DR. GRANT FLEMING, head of the department of medicine of McGill University, died on April 9 at the age of fifty-six years.

DR. F. G. PARSONS, lately professor of anatomy, University of London, and research fellow in anthropology at St. Thomas's Hospital, president of the British Anatomical Society, died on March 11.

SCIENTIFIC EVENTS

VITAL STATISTICS OF ENGLAND AND WALES

IT is reported in the *Journal* of the American Medical Association that a total of 168,638 live births in England and Wales during the September quarter was the highest in any quarter since June, 1930. In comparison with previous third quarters it was the highest since 1926 and represented a birth rate of 16.1 per thousand of population, the highest since 1930. In the quarter 86,893 boys and 81,745 girls were born, a proportion of 1,063 to 1,000, compared with an average of 1,052 to 1,000 for the ten preceding third quarters. Stillbirths numbered 5,425, or 3.1 per cent. of the total births, the lowest percentage yet recorded.

For the first time in any quarter since 1936 the total number of deaths fell below 100,000. The figure was 97,276, which represents an annual death rate of 9.3 per thousand and was lower than that of any third quarter since 1927. It compares with 9.7 for the third quarter of 1941 and an average of 10 for the same quarters of the previous five years. There were 6,766 deaths of infants under one year, a rate of 40 per thousand live births. This was five below the average of the ten preceding third quarters and was equal to the low record that was reached in 1939.

There was a decline in the number of marriages. The total for the quarter of 95,713 was 8,620 fewer than in the corresponding quarter of 1941 and 31,937 below the average for the same quarters of the previous five years. The marriage rate of 18.3 per thousand of population was lower than that of any third quarter since 1936. The explanation of the decline seems to be as follows: The outbreak of war was followed by an increase in the number of marriages, which is now reflected in the rise in the birth rate. This was partly due to the fact that in addition to their ordinary pay soldiers receive allowances for wives and children. The increase in the number of marriages was largely due to earlier ones, thus diminishing those that would take place in the ordinary course in the later years of the war.

APPOINTMENT OF A JUDICIAL COMMISSION ON BACTERIOLOGICAL NOMENCLATURE

AT the third International Congress of Microbiology held in New York City in September, 1939, a series of recommendations of the Permanent International Committee on Bacteriological Nomenclature were accepted at the plenary session of the congress. The third and fourth recommendations were:

That the Nomenclature Committee, as at present constituted, shall continue to function under the auspices of the International Association of Microbiologists as it did under the International Society for Microbiology.

That the International Committee shall select from its membership a Judicial Commission consisting of twelve members, exclusive of members *ex officio*, and shall designate a chairman from the membership of the commission. The two permanent secretaries of the International Committee on Bacteriological Nomenclature shall be members *ex officio* of the Judicial Commission. The commissioners shall serve in three classes of four commissioners each for nine years, so that one class of four commissioners shall retire at every International Congress. In case of the resignation or death of any commissioner, his place shall be filled for the unexpired term by the International Committee at its next meeting.

By prompt action at and subsequent to the congress ballots were cast in spite of war conditions by twenty-six of the sixty-two members of the Permanent Committee on Nomenclature. These ballots when examined by the undersigned joint secretaries of the committee in November, 1942, were found to have resulted in the selection of those whose names appear below. These are grouped in the three classes specified by the permanent committee, those receiving the highest number of votes being placed in the nine-year class, those receiving the next highest in the six-year class, etc. Names in the classes are arranged alphabetically:

Elected for nine years (term normally expires in 1948): R. E. Buchanan, U. S. A.; A. J. Kluyver, The Netherlands; E. G. D. Murray, Canada; S. Orla Jensen, Denmark. *Elected for six years* (term normally expires in 1945): J. Howard Brown, U. S. A.; A. R. Prevot, France; J. Ramsbottom, Great Britain; Th. Thjötta, Norway. *Elected for three years* (term normally would have expired in 1942): A. Lwoff, France; R. Renaux, Belgium; A. Sordelli, Argentine; C. Stapp, Germany.

It has been decided to make this announcement in the hope that some plan for taking tentative action on questions of nomenclature can be developed by those members of the commission who can be reached under war conditions.

While no provision was made in 1939 for the contingencies that have arisen, it is felt that those elected should serve until successors are elected. Professor R. E. Buchanan has been asked to act as chairman *pro tem.* of the Judicial Commission as there is no possibility of securing an election under the rules as adopted.

R. St. John-Brooks (London),
Robert S. Breed (Geneva, N. Y.),
Joint Permanent Secretaries, International Committee on Bacteriological Nomenclature

INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES

The *Experiment Station Record* reports that, according to a recent article in *Agriculture in the Americas,* a site for the Inter-American Institute of Agricultural Sciences has been selected on the outskirts of Turrialba, a town in the interior of Costa Rica approximately midway between the national capital of San José and the principal port of Puerto Limón. The tract chosen for the main buildings and campus consists of 1,235 acres adjoining the Costa Rica Rubber Experiment Station of the U. S. Department of Agriculture. Most of the land has an elevation of about 2,000 feet, but wet lowland areas are included. The soils of the region are volcanic, temperatures average in the middle 70's, rainfall amounts to around 110 inches a year, and the humidity is high. The site is regarded as suitable for experimental cultivation of practically all tropical crops, for experimental work on livestock and dairying under tropical conditions, for the study of tropical reforestation and erosion control problems and for investigation of drainage practices. Near-by areas are well suited for the development of tropical crops not adapted to the lowlands.

The institute is to be managed by a corporation, directors of which will be the members of the Pan-American Union Governing Board, which consists of the United States Secretary of State and the diplomatic representatives in Washington of all the Latin-American republics. Projects will be recommended by a technical advisory committee composed of a member from each of the countries participating. At the outset, the organization will be financed largely by the United States, but it is expected that the other countries will join in the financing later under a convention to be signed.

The institute is conceived as a combination school of agriculture and agricultural research center, the facilities of which will be used by all the American republics. Its objectives, as generally agreed upon by agricultural leaders of the hemisphere, are to provide a place for research on tropical agriculture under favorable conditions, to furnish facilities for training scientific personnel grounded in tropical agricultural problems, to develop mutual understanding among agricultural students of the Americas, to serve as a center for cooperative research projects and to strengthen cultural relations among the American republics.

Plans for the institute contemplate utilization of research facilities offered by the governments of several Latin American republics as well as those of Costa Rica. Among the organizations whose facilities have been offered are the experiment stations of Puerta de Díaz (in Salta) and Loreto (in Misiones), Argentina, situated in the subtropical region of the country; the station located at Chulumani near La Paz and the farms of Trinidad and of Palermo in Santa Cruz, Bolivia; the Agronomical Institute in Belém, State of Pará, Brazil; the experiment station at Palmira, Colombia; the experimental fields situated in the region between the capital and Santa Ana in the large region of Tapachula, State of Chiapas, Mexico; the experiment station at Tingo María, Peru; the Agricultural Experiment Station at Santiago de las Vegas, near Habana, Cuba; and the Institute of Tropical Agriculture at Mayaguez, Puerto Rico.

As previously announced, the director of the institute is Dr. Earl N. Bressman, whose headquarters are expected to be in Washington, D. C., with a small administrative staff. José L. Colom, chief of the division of agricultural cooperation of the Pan American Union, has been appointed secretary of the organization; Rex A. Pixley, business manager of the institute, and Robert A. Nichols, agriculturist in charge of field operations.

THE STUDY OF MEDICINE AND THE CHANGING ORDER

A committee to study medicine and the changing order has been organized by the New York Academy of Medicine. The objectives of this committee are defined as follows:

> To be informed on the nature, quality and direction of the economic and social changes that are taking place now and that are clearly forecast for the immediate future; to define in particular how these changes are likely to affect medicine in its various aspects; to determine how the best elements in the science of medicine and its services to the public may be preserved and embodied in whatever changed social order may ultimately develop.

Members of the committee include:

> Drs. Malcolm Goodridge, *Chairman;* Arthur F. Chase, James Alexander Miller, Alan Gregg, George Baehr, Harry Aranow, I. Ogden Woodruff, Paul Reznikoff, Henry W. Cave, Tracy J. Putnam, Wilson G. Smillie, Jean A. Curran, Herbert B. Wilcox, Howard Craig, E. Tolstoi, E. H. Pool, Robert Pound and Iago Galdston, *Secretary.*

The committee plans to survey the changes that are currently taking place in our economic and social or-

ganization and to consider any changes which are likely to take place during the next decade.

In this survey the committee will solicit information and opinion from a wide variety of groups, including sociologists, economists, representatives of organized labor, industrialists, bankers and politicians. Every shade of political and economic thought is to be represented.

Also, in this connection, the committee will solicit the cooperation of those intimately connected with medicine in the capacities of deans of medical schools, teachers of medicine, hospital authorities, hospital clinicians, public health workers, those interested in graduate education, physicians in industrial medicine, medical social workers and workers in voluntary health organizations.

The committee will welcome suggestions from any one who might propose sources of information which would aid it in this study. It will devote itself primarily to the study of how, within the changing social order, the best qualities in medical service, in medical education and in medical research can be preserved and developed. It is expected that the study will continue until such time as sufficient evidence has been accumulated to make possible a considered report.

OFFICERS OF THE ECOLOGICAL SOCIETY OF AMERICA

OFFICERS, editors and chairmen of the Ecological Society of America have been elected for 1943 as follows:

President, Orlando Park, Northwestern University.

Vice-president, Paul B. Sears, Oberlin College.

Secretary, William A. Dreyer, University of Cincinnati.

Treasurer, Stanley A. Cain, University of Tennessee.

Member of the Executive Committee, S. Charles Kendeigh, University of Illinois.

Editors of Ecology, Thomas Park and Charles E. Olmsted, both of the University of Chicago.

Editors of Ecological Monographs, C. F. Korstian and A. S. Pearse, both of Duke University.

Representative of the National Research Council, Ira N. Gabrielson, U. S. Biological Survey.

Representative of the Union of American Biological Societies, Robert F. Griggs, George Washington University.

Chairmen of Standing Committees:

Preservation of Natural Conditions in the United States, Curtis L. Newcombe, College of William and Mary.

Preservation of Natural Conditions in Canada, J. R. Dymond, Royal Ontario Museum.

Study of Animal and Plant Communities, S. Charles Kendeigh, University of Illinois.

Applied Ecology, John M. Aikman, Iowa State College.

Nomenclature, Frank E. Eggleton, University of Michigan.

Historical Records, Charles C. Adams, State Museum, Albany, N. Y.

Quantitative Ecology, Geoffrey Beall, Dominion Entomological Laboratory, Chatham, Ont.

FELLOWSHIPS OF THE FINNEY-HOWELL RESEARCH FOUNDATION

AT the meeting of the board of directors of the Finney-Howell Research Foundation, Inc., 1211 Cathedral Street, Baltimore, Md., the following annual fellowships were awarded:

For the Third Year

Dr. Rose I. Shukoff, University of Petrograd. To work at the Glasgow Royal Cancer Hospital, Glasgow, Scotland, under Dr. P. R. Peacock.

Dr. Emilia Vicari, the Ohio State University. To work at the Jackson Memorial Laboratory for Cancer Research, Bar Harbor, Me., under Dr. C. C. Little.

For the Second Year

Borroughs Reid Hill, Tulane University. To work at Harvard University with Dr. Louis Fieser.

New

Dr. Nelicia Maier, Medical School, Paris, France. To work at Yale University Medical School with Dr. William T. Salter.

James Alexander Miller, University of Wisconsin. To work at the Medical School, University of Wisconsin.

Fellowships carrying an annual stipend of $2,000 are awarded for the period of one year, with the possibility of renewal up to three years, at the annual meeting of the board of directors, held at the beginning of March. Applications must be made on the blanks furnished by the secretary, and must be filed in the office of the foundation before January 1 of each year. Fellowships are awarded only for research into the cause or causes and the treatment of cancer.

NATIONAL RESEARCH FELLOWSHIPS IN THE NATURAL SCIENCES

THE National Research Fellowship Board in the Natural Sciences of the National Research Council has made the following fellowship appointments for the academic year 1943–1944:

Saul Gerald Cohen (Ph.D. in organic chemistry, Harvard University, 1940). Cornell University. Subject: The effects of changes in structure and experimental conditions on the mechanism of the hydrolysis of esters.

Aureal T. Cross (Ph.D. in botany, University of Cincinnati, 1943). University of Illinois. Subject: The value of plant microfossils for the stratigraphic correlation of coals, based on a study of the commercial coals of West Virginia.

William Hovanitz (Ph.D. in genetics, the California Institute of Technology, 1943). Place of study not yet determined. Subject: Genetics of physiological races in mosquitoes, with special reference to transmission of immunity.

Foil Allan Miller (Ph.D. in chemistry, the Johns Hopkins University, 1941). University of Minnesota. Subject: The vibrational spectra of molecules.

Paul Charles Rosenbloom (Ph.D. in mathematics, Stanford University, 1943). Indiana University—on a participating basis. Subject: Enumeration of metabelian groups of prime power order.

Helen Rawson Steel (Ph.D. in astronomy, Radcliffe College, 1943). University of Chicago. Subject: The astrophysical theory of absolute-magnitude criteria in stellar spectra.

Dolores Rose Terwoord (Ph.D. in chemistry, Catholic University of America, 1943). University of Chicago. Subject: Studies of the photosynthetic activity of plant extracts.

Herman A. Witkin (Ph.D. in psychology, New York University, 1939). New School for Social Research. Subject: The role of visual and postural factors in the determination of the constancy of the perceived vertical and horizontal.

SCIENTIFIC NOTES AND NEWS

Dr. Walter Savage Landis, vice-president of the American Cyanamid Company, has been awarded the gold medal for outstanding services to the science of chemistry of the American Institute of Chemists, in recognition of "his contribution to engineering and development work largely in the field of nitrogen derivatives, and for his services to the professional side of chemistry." The presentation will be made at the banquet on May 15 at the annual meeting of the institute. Dr. Gustav Egloff, president of the institute, will present the medal. Addresses will be made by Dr. Maximilian Toch on "Landis, the Man," and Harry L. Derby, president of the American Cyanamid and Chemical Corporation, on the achievements of Dr. Landis.

Professor Ellsworth Huntington, of Yale University, is the recipient of the Distinguished Service Award of the National Council of Geography Teachers. The citation mentions his several widely used text-books, his many thought-provoking articles and his more than a score of scholarly volumes. He is characterized as the world's most widely known geographer, because parts of his work have deeply interested workers in several disciplines, including geography, geology, climatology, sociology, history and eugenics. Previous recipients of this award, last bestowed in 1940, include Isaiah Bowman, Mark Jefferson and J. Russell Smith, and the late W. M. Davis, R. H. Whitbeck and A. E. Parkins. Each of these seven men had been president of the Association of American Geographers.

At the meeting of the Society of Experimental Psychologists held on April 9 at Columbia University, the Howard Crosby Warren Medal was awarded to Professor Stanley Smith Stevens, of Harvard University. The citation reads: "His analysis of psychological pitch has revealed both its quantal structure and its functional relation to stimulus-frequency."

Dr. Florence Seibert, associate professor of biochemistry at the Phipps Institute, University of Pennsylvania, was presented on April 13 with the first $2,500 achievement award of the American Association of University Women. The presentation was made by Dr. Kathryn McHale, of Washington, general director of the association, at ceremonies in the Philadelphia branch headquarters of the association. The monetary award was designed to help Dr. Seibert with her research in tuberculosis.

The Royal Astronomical Society has awarded its Gold Medal to Dr. H. Spencer Jones, Astronomer Royal, for his determination of the solar parallax.

The William Julius Mickle Fellowship of the University of London has been awarded to Professor E. C. Dodds, Courtauld professor of biochemistry at the Middlesex Hospital Medical School.

It is stated in the *Times*, London, that Major Sidney H. Bingham, U. S. A., is the first American officer in the war to be elected a member of the British Institution of Mechanical Engineers.

Officers of the International Association for Dental Research have been elected as follows: Philip Jay, University of Michigan, *President;* H. Trendley Dean, U. S. Public Health Service, *President-elect;* and Wallace D. Armstrong, University of Minnesota, *Vice-president*. E. H. Hatton, Northwestern University, was reelected *Secretary-treasurer*.

After twenty-five years at Kansas State College, seven years as dean of the School of Agriculture and director of the Agricultural Experiment Station and eighteen years as president, Dr. F. D. Farrell has resigned and will become president emeritus on July 1.

The retirement is announced of Sir Frederick Gowland Hopkins, for nearly thirty years professor of biochemistry at the University of Cambridge. Sir Frederick is eighty-two years of age.

Theodore B. Parker, chief engineer of the Tennessee Valley Authority, has been appointed head of the department of civil and sanitary engineering of the Massachusetts Institute of Technology. He succeeds Professor Charles B. Breed, who asked to be relieved of administrative duties so that he might devote full time to the professorship of civil engineering.

THE following have been promoted to associate professorships at Yale University: Werner Bergmann, chemistry; Nelson Dunford, mathematics; Clarence W. Dunham, civil engineering; Erwin B. Kelsey and George M. Murphy, chemistry; Abraham White, physiological chemistry, and Ernest C. Pollard, physics.

JAMES R. KILLIAN, JR., has been made executive vice-president of the Massachusetts Institute of Technology. Mr. Killian has been executive assistant to the president since January, 1939, and takes over his new post on July 1.

GEORGE H. MACNAB has been appointed dean of Westminster Hospital School of Medicine, London, in succession to Sir Adolphe Abrahams, who has retired.

THE British Minister of Aircraft Production has appointed Sir B. Melvill Jones, F.R.S., professor of aeronautics at the University of Cambridge, chairman of the Aeronautical Research Committee in succession to Sir Henry Tizard, who has retired after serving for ten years. Sir Melvill has been a member of the committee for some years.

DR. MORDECAI EZEKIEL, personal adviser to Charles E. Wilson, executive vice-chairman of the War Production Board, has returned to his former post as economic adviser to the Secretary of Agriculture.

DR. ALEXANDER SILVERMAN, head of the department of chemistry of the University of Pittsburgh, has been appointed consultant on glass to the Office of Production Research and Development of the War Production Board. His headquarters will be at the university.

T. G. ANDERSON, assistant professor of bacteriology at the Pennsylvania State College, has leave of absence to serve as a lieutenant in the Sanitary Corps, U. S. Army.

DR. G. H. PARKER, of Harvard University, lectured on animal chromatics before the Science Club at Amherst College on April 12.

THE Royal Canadian Institute of Toronto was addressed on March 20 by Professor Charles H. Behre, Jr., of Columbia University, who spoke on "The Mineral Resources of Europe." On March 22 he spoke before the department of geology of the University of Toronto on "Structural Control in Lead-Zinc Deposition of the 'Mississippi Valley' Type."

DR. LINUS PAULING, director of the Gates and Crellin Laboratories of Chemistry of the California Institute of Technology, delivered an address entitled "Chemical Studies of the Structures of Antibodies" at the three hundred and nineteenth meeting of the Washington Academy of Sciences, which was held on April 22 jointly with the Chemical Society of Washington.

DR. FOSTER KENNEDY, professor of neurology at the College of Physicians and Surgeons, Columbia University, will give the H. B. Shmookler Memorial Lecture at the Mount Sinai Hospital Conference Hall, Philadelphia, on May 3. He will speak on "Neuroses in Warfare."

THE second annual lecture under the Charles Fremont Dight Institute for the Promotion of Human Genetics was delivered at the University of Minnesota on April 19 by Dr. L. H. Snyder, chairman of the department of zoology of the Ohio State University. Endowed to the extent of more than $100,000 under the will of the late Dr. C. F. Dight, at one time a member of the Minneapolis school board, the foundation is a part of the department of zoology of the University of Minnesota and is under the direction of Dr. C. P. Oliver. Its purposes are promotion of interest in human genetics, accumulation of genetic statistical data from interesting families and public service through making information available to those whom it can help. Dr. Snyder's lecture was entitled "Heredity and Modern Life."

ROYAL SOCIETY lectures have been announced as follows: Bakerian Lecture, June 17, "Relaxation Methods, a Mathematics for Engineering Sciences," by Dr. R. V. Southwell, F.R.S.; Croonian Lecture, July 15, "Recent Developments in Chemotherapy with Special Reference to Tropical Medicine," by Professor Warrington Yorke, F.R.S.; October 14, Lecture to commemorate the bicentenary of Lavoisier's birth, "Antoine Laurent Lavoisier," by Sir Harold Hartley, F.R.S. The lectures will be delivered in Burlington House, London.

THE twenty-fourth annual meeting of the American Geophysical Union will be held at George Washington University, Washington, D. C., on April 23 and 24.

THE thirty-fourth annual meeting of the American Oil Chemists' Society will be held in New Orleans on May 12, 13 and 14.

THE summer meeting of the American Physical Society in the East will be held at Pennsylvania State College on June 17, 18 and 19, in conjunction with the American Association of Physics Teachers. The summer meeting in the West will be held at Stanford University, California, on July 10.

THE fourteenth annual meeting of the Eastern Psychological Association will be held at Hunter College, New York City, on April 30 and May 1. Dr. Gordon W. Allport, of Harvard University, will deliver the presidential address on the evening of April 30.

THE fifth annual summer conference of the New England Association of Chemistry Teachers will be held from August 27 to 30 at Phillips Academy,

Andover, Mass. The program is divided into two parts—(1) Strategic materials and (2) Chemistry teaching in the war effort. Under this latter topic considerable attention will be devoted to the participation of the teacher of chemistry in civilian defense activities. It is also planned to offer lecture demonstrations to run throughout the conference. While the summer conferences are held primarily for the benefit of members of the association, any one interested will be welcome. Further details will be published in the May issue of the *Journal of Chemical Education* and the completed program will appear in the July issue. Communications concerning the conference should be addressed to the secretary, Amasa F. Williston, B.M.C. Durfee High School, Fall River, Mass.

A NATIONAL WARTIME CONFERENCE of the professions, arts, sciences and white-collar fields will be held in the Hotel Commodore on May 8 and 9 under the sponsorship of eighteen national organizations and two hundred individuals who are leaders in these four groups. Dr. Kirtley F. Mather, professor of geology at Harvard University and president of the American Association of Scientific Workers, is chairman of the conference. Miss Olive Van Horn, industrial secretary of the National Board, Young Women's Christian Associations, is the executive secretary. The purpose of the conference, according to the sponsors, is to find ways by which fuller use can be made of the available skill and talent which still lies untapped throughout the country. The keynote address of the opening session of the conference on the afternoon of May 8 will be delivered by Professor Mather. Dr. Leonard A. Carmichael, president of Tufts College and director of the National Roster of Scientific and Specialized Personnel, will speak on the present and potential contribution of trained personnel to the war effort, and Dean Wayne Morse, public member of the National War Labor Board, will speak on economic stabilization and the problems of salaried professionals. There will be six panel discussions on May 9, dealing with health and welfare services, education, arts and letters, white-collar fields, and science and technology.

THE Palo Alto Museum, California, according to *Museum News,* has made plans to open its new Science Wing to the public on Easter Sunday, April 25. At the dedication ceremony the building will be presented to the City of Palo Alto by Mrs. Don Hibner, president of the museum. Mayor Byron Blois will accept for the city. There will be a preview and reception for members and guests on April 24, when Robert C. Miller, director of the California Academy of Sciences, will be the guest speaker.

DISCUSSION

THE SCIENCE MOBILIZATION BILL

A PLAN FOR THE MAXIMUM WARTIME UTILIZATION AND COORDINATION OF SCIENCE AND TECHNOLOGY

IN an article in SCIENCE (December 25, 1942), Professor Theodor Rosebury mentioned a bill to set up an Office of Technological Mobilization which had been Introduced in the last Congress. The objectives of this bill had been studied and approved by the New York branch of the American Association of Scientific Workers, which also suggested certain modifications in the proposed legislation. The bill has now been reintroduced in modified form as the Science Mobilization Bill, which is being sponsored in the Senate by Senator Harley M. Kilgore (S. 702) and in the House by Representative Wright Patman (H.R. 2100).

The new bill begins with an important statement of policy which stresses the importance of science and technology in aiding the war effort. "The Congress hereby recognizes that the full development and application of the nation's scientific and technical resources are necessary for the effective prosecution of the war and for peacetime progress and prosperity . . ."

It then points out five "serious impediments thereto . . ."

(1) *Lack of information:* "the unassembled and uncoordinated state of information concerning existing scientific and technical resources";

(2) *Lack of planning:* "the lack of adequate appraisal, and the unplanned and improvident training, development, and use, of scientific and technical personnel, resources and facilities in relation to the national need";

(3) "the consequent *delay and ineffectiveness* (ital. ours) in meeting the urgent scientific and technical problems of the national defense and essential civilian need";

(4) "*the trend toward monopolized control* of scientific and technical data and other resources with lack of access thereto in the public interest; and"

(5) *Lack of coordination:* "the absence of an effective Federal organization to promote, coordinate, in the national interest, scientific and technical developments."

Evidence that such "serious impediments" to the full application of science in our war effort do in fact exist has come from many sources. Not the least important of these are the hearings of the various committees of the Senate, such as the Kilgore, Truman and Gillette committees. To overcome these "serious impediments" the Science Mobilization Bill proposes

to establish an Office of Scientific and Technical Mobilization. OSTM will receive wide powers. The sum of $200,000,000 is to be appropriated for the use of the Office. It will be empowered to conduct and to finance scientific and technical work, to acquire patents and industrial processes, and to establish a system of awards for outstanding scientific and technical contributions. OSTM is to survey facilities, personnel and requirements; to formulate programs for the development and use of facilities and personnel; and to provide and promote scientific and technical training. It is to assess scientific and technical developments in relation to their impact on the national welfare; to foster international scientific co-operation; to acquire information from other countries and to exchange information and personnel with such countries; and it is to engage in other suitable forms of international collaboration relating to science and technology.

The National Roster is to be transferred with all its powers, personnel, records and funds to the OSTM and the Selective Service Act is to be amended to enable the Administrator of OSTM to certify occupational deferments for scientific and technical personnel that are needed in the war effort.

During the war and for a period not exceeding six months thereafter, the Administrator of OSTM is empowered to put into use any scientific or technical facility, license or patent which is needed for the defense of the nation or for the prosecution of the war. This provision is subject to elaborate and appropriate safeguards and to a guarantee of adequate compensation. All inventions, discoveries and patents which result from the support of the OSTM are to be vested in the Office, which may give nonexclusive licenses for their use. Suitable monetary rewards are to be given to the individuals who made or contributed to the discoveries or inventions.

The Science Mobilization Bill provides an admirable illustration of the manner in which science and its fullest utilization both for war and for peace can be "planned" or coordinated for the benefit of the community without adversely affecting the research freedom of scientists. In fact, it seems to provide a mechanism whereby there can be achieved a great liberation of science from many of its present hindrances and whereby science can undergo great expansion in its work for the benefit of the nation. The bill thoroughly deserves to be read and carefully considered by all scientists who are interested in achieving the fullest utilization of science in the present struggle and in the future activity of a fruitful peace.

Also worth careful study are the three volumes of hearings which have already been published by the sub-committee on Technological Mobilization of the Senate Military Affairs Committee. These volumes contain illuminating discussions on the confusion which exists in regard to rubber, aluminum, sponge iron and other critical problems of our war production. Testimony exposes the failure to make full use of the National Roster. The hearings also show how special interests have often hindered the full application of rational scientific and technical procedures.

The hearings also include certain criticisms of the bill as it was introduced last year. These criticisms, too, should be carefully considered. Some of them have already been taken into account in the present Science Mobilization Bill. Recently, however, there seems to have been initiated a campaign of considerable proportions which attacks the bill on the grounds that it will lead to "regimentation" of science and technology. Study of the bill itself and of the testimony presented at the Senate hearings gives no support for this campaign. The evidence shows clearly that a reorganization of our scientific and technical establishment such as is contemplated in the bill will enhance the effective utilization of our scientific resources in the war effort and will make science a more potent force in the welfare of the nation. Coordination and support of scientific and technical work by a government agency need be no more "dictatorial" than is the administration of civil aeronautics, of communications, of the Public Health Service and of the many other valuable services performed by the Federal Government. The proposed Office of Scientific and Technical Mobilization will provide a mechanism which is sorely needed at present, for receiving and developing new ideas concerning the application of research and technology to the war effort. Through the scientific representatives on the Board of OSTM and through the Administrator of the Office, scientists and technologists for the first time will be given an opportunity to take part in the decision of national policies and will have a freer hand than at present in the support and conduct of scientific and technical activities.

The demands of the war effort are bringing forth in Great Britain also a vigorous campaign in favor of better organization and planning of science. The Association of Scientific Workers recently held an important two-day conference on "The Planning of Science" which received very wide support in British scientific and technical circles. *Nature* (February 6 and 20, 1943) has published lengthy summaries and an editorial approving the aims of the conference.

The lack of coordination which is observable in the field of science and technology is also found in other fields of our war effort. These defects have been made clear through a notable series of investigations by the Tolan Committee of the House and by the Truman, Murray, Gillette, Pepper and Kilgore Committees of the Senate. A large group of Senators has therefore introduced jointly a bill (S. 607) to

set up an Office of War Mobilization. All existing war agencies, including the Office of Scientific and Technical Mobilization, are to be brought under the coordination and guidance of the Office of War Mobilization.

Widespread individual information is the basis of an intelligent democracy. Scientists, academic and applied, would have a more direct interest than most other groups of our citizens in the proposed Office of Scientific and Technical Mobilization and a very great interest in the proposed Office of War Mobilization. They would do well to obtain copies of the bills and hearings to acquaint themselves with the terms and ideas embodied in them.

K. A. C. ELLIOTT,
Chairman, Philadelphia branch, American Association of Scientific Workers
HARRY GRUNDFEST,
National Secretary, American Association of Scientific Workers

CARIBOU AND THE MEAT SHORTAGE

MANY of our people seem concerned about the shortage in meats, which have been strictly rationed since March 29. As regards our home population it is not likely that this shortage will be serious; and it may even be an advantage, for at least the sedentary section now overeats and especially of proteins. If this were not sufficiently indicated by the tubby figure and especially by the protruding paunch of the average business man in middle life, it is confirmed by the unexpected, but considerably improved health of the British people since rationing was instituted there.

However, it is essential that our armed forces and our manual working population be supplied with an adequate protein diet, and it is pertinent to draw attention to a considerable supply of meat available in Alaska.

Since the beginning of the century there have been domesticated caribou (reindeer) herds in Alaska. Ten years ago estimated to number two hundred thousand to half a million, they have been now reduced to from fifty thousand to one hundred thousand. The wild caribou herds are estimated as between one and two millions of individuals, with other millions in Canada.

All those who have been privileged to eat caribou meat in the North will, I think, agree with me that it surpasses in its palatable qualities the best beef or the best venison. Caribou meat has something of the gamy flavor of venison, but in its juiciness it is more like beef. Already for a good many years caribou steaks have been obtainable in certain restaurants in this country, but the sale has never been large, partly because of the difficulty of overcoming inertia which favors the continued use of beef, mutton and pork, but mainly because of the opposition of the United States cattle and sheep men.

As the domesticated herds are largely in northwestern Alaska near the Bering Sea, it would be possible to ship the refrigerated meat by sea to our bases in the Southwest Pacific and to our own Pacific ports.

WM. H. HOBBS

UNIVERSITY OF MICHIGAN

SCIENTIFIC BOOKS

ORGANIC CHEMISTRY

Organic Chemistry. By G. ALBERT HILL and LOUISE KELLEY. viii + 919 pp. 6 × 9 in. Bound in dark blue cloth. Philadelphia: The Blakiston Company. 1943. $4.00.

THE authors of this new text are both leading professors of organic chemistry, one at Wesleyan University and the other at Goucher College, the former with considerable experience in the teaching of the subject to men, and the latter's teaching experience having been with women students. A collaboration of this kind should be mutually stimulating and helpful.

The result is a well-balanced presentation of the subject in its manifold and diversified aspects, theoretical and practical; including the purely descriptive side of preparation, properties and applications; the theoretical considerations underlying the behavior of certain molecules and the immensely important role of organic chemistry in the maintenance and progress of our present civilization and industries.

The volume contains 46 chapters, a glossary (mainly of medical terms), an explanation of symbols and Greek letters used and a good subject index. If it is intended to serve as a reference book, as well as a text, as its authors state in their preface, its lack of citations of the original literature and of pertinent bibliographies to supplement the necessarily restricted information given in so vast a field is regrettable.

The introductory chapter discusses the nature of atoms and of atomic linkages, including types and strength of bonds, bond angles, rotation about bonds, distances between atoms and anomalous valences; molecules, dipole moments, resonance, hydrogen bridges; the mechanism of organic reactions and the primary divisions of organic compounds into aliphatic, aromatic and heterocyclic.

The succeeding chapters present the various groups of organic compounds in the usual order, beginning with the hydrocarbons, then the alcohols and ethers, halogen derivatives, aldehydes and ketones, etc.

A helpful feature is the explanation of the generally accepted International Union of Chemistry (I.U.C.) system of nomenclature. In the chapter on "Heterocyclic Compounds," attention should have been called to the ring index, a *vade mecum* which is indispensable to all students and investigators in this branch of organic chemistry.

Liberally illustrated with structural formulas and provided with tabular summaries of important series and their properties, nearly every chapter concludes with a list of test questions. Considerable attention is given throughout the book to the use of organic compounds in medicine, and the final chapter gives a compact up-to-date review of polymerization, synthetic rubbers and plastics.

The subject-matter is well classified and arranged, lucidly and logically presented, covering the subject admirably within its space limitations, so that the book should prove a very useful and interesting first-year college text and as a foundation for more advanced and more highly specialized courses.

In paper, type, printing and binding in vermin-proof and water-resisting material, the book is up to the usual high standard of all recent Blakiston publications.

Marston Taylor Bogert

BIOLOGICAL SYMPOSIA

Sex Hormones. Edited by F. C. Koch and Philip E. Smith. 146 pp. The Jaques Cattell Press. 1942. $2.50.

The ninth volume of "Biological Symposia" is a presentation of eight papers delivered in a symposium on "The Comparative Biology and Metabolism of the Testicular and Ovarian Hormones," presented as part of the fiftieth anniversary celebration of the University of Chicago in September, 1941. The book has two sections: I. Sex hormones—their actions and metabolism; II. Hormonal factors in the inversion of sex.

A broad and thoughtful introductory chapter by Professor Carl Moore is followed in Section I by three more meaty disquisitions by Dr. A. T. Kenyon, Professor E. A. Doisy and Professor F. C. Koch. They discuss, respectively, the metabolic influences of gonadal hormones, the metabolism of estrogens and the metabolism of androgens.

Dr. Kenyon's is an informative account in biochemical terms of the purely somatic effects of the sex hormones. It is in essence a description of the pioneering in a field that is bound to expand and develop. His data are derived chiefly from observations on human subjects and thus give point to the need for well-controlled experiments with animals.

Professor Doisy's paper is by contrast an essay in comparative biochemistry. In a balanced survey of the chemical changes undergone by estrogens in the animal body, Professor Doisy brings order to a subject hitherto confused by purely technical difficulties. The informed reader will find this chapter a welcome corollary to Doisy's previous writings in this field.

Professor Koch's lucid chapter is an admirable synthesis of biochemical theory and clinical findings. Proceeding from the studies of androgen and steroid excretion in human subjects, normal and abnormal, to the little-known but highly interesting data on the bacterial metabolism of steroids, Professor Koch develops an excellent general picture particularly of the catabolic fate of androgenic substance. His critical account of modern theories concerned with the origins of androgenic hormones is especially clear and interesting.

In the second section of the book are papers on experimental sex inversion in the plumage of birds (by Professor C. H. Danforth), in Amphibia (by Professor R. R. Humphrey), in the rat embryo (by Dr. R. R. Greene) and in the opossum (by Professor R. K. Burns, Jr.). These papers are concerned in varying degree and detail with the bipotentiality of various somatic responses to endogenous or exogenous androgen and estrogen, particularly in embryonic life. The much more surprising effects of the sex hormones upon differentiation of the embryonic gonads are carefully detailed, from the almost complete sex reversal in certain amphibia to the sterilization in mammalian embryos. The reviewer is struck by the contrast between the biochemical analysis of the first section and the morphogenetic detail of this section. In the study of sex inversion a large biochemical gap needs bridging. The dichotomy of response of gonad cortex and medulla, Mullerian and Wolffian duct, to various steroid hormones has had a real embryological demonstration. A biochemical basis for such dichotomy is woefully lacking.

These factual summary presentations illustrate in part the dramatic development of our knowledge of steroid hormone function. I doubt that Professor Doisy realized in 1929 the consequences of his chemical isolation of theelin. His few crystals initiated the deluge of steroid hormones—androgens, progestins, estrogens, cortins. Their biological activities extend from conception to senescence. Their roles in a host of physiological processes are slowly becoming clear. This book has the special merit of shaping that clarity from a large and formless literature.

Gregory Pincus

Clark University

VITAMINS

The Biological Action of the Vitamins. Edited by E. A. Evans, Jr.

This book, which takes one close to the heart of the problem, is composed of fourteen invitation papers, presented at the fiftieth anniversary celebration of the

University of Chicago in September, 1941. The titles of the papers describe adequately the subjects covered, and the names of the participants are a guarantee of the quality of the contribution. The book will be of particular interest to the serious student and to the progressive physician. A study of it shows how extremely diverse are the various factors which come in its wide range. The contributors realize fully the vastness of the subject and very wisely make no attempt to present a mass of indirectly related experimental data which would merely serve to bewilder. The references are skilfully dovetailed into a clear account. The book is full of stimulating ideas. It is readable, comprehensive and authoritative. In many ways, the present and the past are in conflict, but the references represent the cream of the literature of both. The theories discussed are based upon scientific inquiry and, for the most part, they have proved to be sound.

Each of the fourteen papers is written by an expert who usually attempts to correlate the chemistry, physiology and clinical aspects of the cellular metabolism concerned with thiamine, riboflavin, nicotinic acid, pyridoxine, pantothenic acid, biotin, choline, phosphorus and vitamin K. The delightful personal touch in some of the papers is not often found in scientific publications. Each answers a number of questions but asks many more, especially in the clinical field. In general, the history of the individual members of the vitamin B group is reviewed from the time of their discovery up to and including current investigations. This book is especially valuable for all those interested in working on problems related to the vitamins, whether they be pure scientists or clinicians. Science students interested in the subject will find that it has a great deal of material which will be of value to them.

Tom D. Spies

REPORTS

THE WORK OF THE ROCKEFELLER FOUNDATION[1]

The Year in Brief

In 1942 the appropriations of the Rockefeller Foundation amounted to $8,227,867. This is in contrast to $9,313,964 appropriated in 1941. The income of the foundation from investments during the year was $8,271,037, as compared with $8,734,992 in 1941.

The appropriations in 1942 were distributed for the most part in six major fields, roughly as follows:

Public health	$2,700,000
Medical sciences	1,434,000
Natural sciences	815,000
Social sciences	1,326,000
Humanities	982,000
Program in China	122,000

A detailed statement of the appropriations made in 1942 appears at the conclusion of this report, beginning on page 53. Of the money appropriated during the year, 67 per cent. was for work in the United States and 33 per cent. for work in other countries. The amount spent in foreign countries was larger than in any year since 1937, and represents an increase of 30 per cent. over the average of the years 1938 to 1941. This increase is due to two causes: first, the developing program of the foundation in Latin America, and second, the growing needs of the foundation's Health Commission in connection with war activities abroad.

In contrast with the size of public funds now being spent to meet the present emergency, the eight million dollars which the foundation appropriated in 1942 seems insignificant. It is estimated that eight million dollars would take care of the current war expenditures of the United States Government for approximately forty-five minutes. But in times like these, when the intellectual and cultural life of mankind has to be subordinated to a struggle for survival, even a relatively small sum may be used effectively to help build a bridge between what men have valued in the past and what they hope to maintain in the future.

Values Not Easily Regained

In this "Review," three years ago, under the heading "Night over Europe," an attempt was made to describe the disaster which the war was bringing to universities and laboratories both in England and on the Continent. The processes of disintegration had already begun. Institutions dedicated to the extension of knowledge were being geared into the war machine. The necessities of military mobilization had decimated faculties and student bodies alike. Cultural values upon which civilization is based were being thrown to the winds as the intellectual blackout spread across half the world.

To-day the long shadows of the blackout are lengthening inexorably over the United States. We are fighting for a future in which free institutions can live, but to achieve that end we are sacrificing values which, once they are lost, are not easily regained. The crisis presents us with a problem of delicate balance, how to win the war and at the same time preserve those intellectual ideals and standards, those "great things of the human spirit," without which a military victory would in the end be nothing but ashes. History shows

[1] Review of work in 1942 by Raymond B. Fosdick, president.

us that it is possible to lose a civilization even while armies and navies are triumphant.

As in Europe, so here at home, liberal education has been discarded for the duration. Our universities are now instrumentalities of total war. Technology is left as the one subject which must be taught. History, economics, literature, philosophy—the whole range of the social sciences and the humanistic studies—have been crowded out of the picture by the pressure of higher priorities. Our young men are not to be trained in liberal understanding; they must be made into soldiers. Of necessity, their education must be an education in violence. Their participation in the cultural and social heritage of civilization is adjourned. For the time being, at least, their generation may not share in the humane tradition on which alone the building of a worth-while future depends.

Not only the undergraduate work of our colleges and universities but the activities of many of our post-graduate departments, and of our research staffs and laboratories, are being forced to pay the price which war, however necessary, inevitably exacts. On all sides, fundamental research, except as it relates to the demands of war, is being curtailed or abandoned, as scientists, technicians and students are mobilized for practical types of service. Illustrations of this situation are to be found in almost every branch of knowledge, whether it is biophysics or genetics or agriculture or economics or anthropology or the fine arts. The completion of the 200-inch telescope in California has been indefinitely postponed. The cyclotrons of the country have for the most part been forced to shut down or greatly limit their programs in pure research. Graduate schools across the land are only partially occupied; faculties are becoming scattered. And this is only the beginning of the dislocation; the end is by no means in sight. In time of war the advance of knowledge for the sake of knowledge becomes a luxury which a nation fighting for its life apparently can not afford.

These comments are made in the full realization that we have a war on our hands which must be fought to a victorious finish. But in the achievement of this purpose we need to keep in perspective the requirements of the future as well as the demands of the present. The treasure of learning and the liberal tradition can not be reassembled, like automobiles in a plant, when the long convulsion is finished; nor can scientists, doctors, scholars, philosophers and artists be fabricated over night. We need to keep soberly in mind the price we are paying for victory—not in terms of dollars, nor indeed wholly in terms of human life, but in terms of values by which the worth of a civilization is ultimately measured. Our enemies kill the humane tradition wherever they can; in the realm of the mind and soul it is their chief adversary. Our concern must be that in fighting this barbarian concept we do not inflict so serious a wound upon the intellectual and spiritual life of our country that, though barbarism is conquered without, it finds a low resistance to growth within.

These observations lead to one conclusion. Our schools, our colleges and universities and all the institutions and individuals concerned with the quest for a rational life among men have a dual responsibility in these stern days. We must of necessity serve the war effort, for there is no future for what we most desire in a world dominated by fascism. But we have a responsibility equally compelling to preserve the treasures of the spirit which we hold in trust from the past for the benefit of the generations to come. There must be no broken link in the chain, no flaw in the title deeds by which what we most cherish is transferred to the future.

The Corporation of Yale University, in a recent statement, expressed in the following words its feeling of responsibility as a "custodian of our cultural heritage":

> The Corporation wishes to impress upon Yale graduates and upon the general public the danger of the impoverishment of the nation's mind and soul, should the less tangible values of our culture be allowed to shrivel while our energies are devoted to the task of winning a war to maintain them. Of what worth is freedom from want, if our minds be on a lower intellectual level; or freedom from fear if we have a less cultured life to defend; or freedom of speech if we have poorer thoughts to express; or freedom of religion if we bring a less enlightened faith to the worship of God?

This obligation is laid on the doorsteps of all our educational institutions. It is to them that we look for perspective and leadership in such an hour as this. If they can not carry their responsibility, nobody else will, for nobody else can. In their absorption in military necessities they must not allow themselves to be mere appendages of the war machine. They must not abdicate their high purpose. Unless they keep the candles lit which have largely flickered out elsewhere around the world, we may reach the dim aftermath of war, with victory behind us, but with not enough light left to make it mean anything in terms of a brighter world.

In 1881 the College of William and Mary in Virginia closed its doors for nearly seven years. The battles of the Civil War had been fought up and down the Peninsula and had left the college physically in ruins; and although it struggled to keep going during the bitter time of reconstruction, it was finally overborne by financial catastrophe. But every morning during these seven barren years President Ewell rang the chapel bell. There were no students; the faculty

had disappeared; and rain seeped through the leaky roofs of the desolate buildings. But President Ewell still rang the bell. It was an act of faith. It was a gesture of defiance. It was a symbol of determination that the intellectual and cultural tradition must be kept alive, even in a bankrupt world.

In every school, college and university of America to-day we need to hear that bell ringing.

SPECIAL ARTICLES

THE RELATIONSHIP OF VITAMIN A TO RESISTANCE TO NIPPOSTRONGYLUS MURIS

A CRITICAL study of the work of Spindler[1] revealed the fact that lack of vitamin A in the diet lowered the resistance of albino rats to a superinfection with the nematode, *Nippostrongylus muris;* but details were lacking as to the composition of the diet or the extent of the vitamin A deficiency in the experimental animals. It seemed necessary that further work should be done, by methods somewhat similar to those employed by McCoy[2] with *Trichinella spiralis,* and by Lawler[3] with *Strongyloides ratti;* these workers correlated vitamin A deficiency with susceptibility.

It is the purpose of the present paper to give the findings obtained under controlled diet, and with chemical determination of liver vitamin A, on the influence of vitamin A depletion on the resistance of the pied stock rats, McCollum strain, to primary infection and subsequent reinfections with *Nippostrongylus muris.*

In carrying out the tests referred to in this paper, the experimental and control animals were divided into groups such that sex and weight distribution were fairly uniform. The rats averaged 70 to 80 grams in initial weight. The experimental groups were fed, ad lib, two different diets deficient in vitamin A: Diet I the yeast diet and Diet II the "synthetic" diet, respectively; and the control groups were fed the same diets plus a supplement of vitamin A, such that each rat received 150 I. U. per week. The supplement was a vitamin A concentrate diluted with sesame oil, and fed in three weekly doses by medicine dropper. The composition of the two diets will be reported in detail later.

Chemical Methods: The vitamin A content of the liver was used as an index of relative depletion. The entire liver was excised, weighed and ground up with anhydrous Na_2SO_4 until a uniform powder was obtained. An aliquot portion of liver powder was extracted with 15 cc of petroleum ether in a test tube; after centrifuging, a 10 cc portion of this extract was transferred to an Evelyn photoelectric colorimeter absorption tube. The extract was evaporated to dryness in a stream of dry CO_2, with the tube immersed in a water bath at 55–60° C. The residue in the tube was taken up in 1 cc of chloroform, and the vitamin A content determined by the addition of 9 cc of Carr-Price reagent (25 gms of $SbCL_3$ in 100 cc of $CHCL_3$), with the colorimetric measurement of the blue color developed in the Evelyn photoelectric colorimeter. The blood vitamin A was determined by the method of Kimble.[4]

Parasitological Methods: Infective larvae (isolated by means of Baermann's apparatus from 9–10 day charcoal cultures of feces of infected rats) were counted by the dilution method, suspended in known volumes of water, and injected subcutaneously into the rats to be infected. At subsequent autopsy, worms found in the intestines were counted. To determine the number of larvae in the lungs, these organs were removed at autopsy and cut into small pieces, pressed between two plate-glass slides (2″ × 3″) and examined microscopically for the presence of larvae.

RESULTS

Experiment 1. The effect of vitamin A depletion upon susceptibility to primary infection. After being on the stated diets for 56 days, the average weight of the 24 rats reached about 140 grams. On the 57th day, each of these animals was given 2,300 *N. muris* larvae, and was sacrificed 12 days later. Post-mortem determinations revealed a complete depletion of vitamin A in the livers, and low vitamin levels in the blood, of the animals receiving vitamin A-deficient diets. These animals harbored more worms in the intestines than those on the same diets supplemented with vitamin A concentrate. It will be noted further that three rats fed on Diet I-a and two rats fed on Diet II-a died on the fifth and sixth days following infection with the larvae; whereas all the control animals, though given the same number of larvae, survived (see Table 1).

Experiment 2. The effect of vitamin A depletion upon susceptibility to subsequent reinfections. Rats, the average weight of which was between 70 and 75 grams, were "hyperimmunized" by means of serial infections with 2,000 larvae each. The first infection ran its course for two weeks; 2,000 additional larvae were then administered, followed by a third infection of 2,000 larvae two weeks later. Three weeks after the last infection the animals were divided into groups, according to the diets administered.

After being on the experimental diets for 79 days, the average weight of the 22 rats reached about 180

[1] L. A. Spindler, *Jour. Parasit.*, 20: 72, 1933.
[2] O. R. McCoy, *Amer. Jour. Hyg.*, 20: 169, 1934.
[3] H. J. Lawler, *Am. Jour. Hyg.*, 34 (Sec. D): 65, 1941.
[4] M. S. Kimble, *Jour. Lab. Clin. Med.*, 24: 1055, 1939.

grams. On the 80th day, each animal was given 2,000 *N. muris* larvae and was sacrificed 12 days later. Post-mortem determinations revealed a complete depletion of vitamin A in the liver and low vitamin A levels in the blood of the animals on the vitamin A-deficient diets. More worms were found in the intestines, but fewer worms in the lungs, of these animals; in the control animals the reverse condition was seen. See Table 1.

TABLE 1

Experiment	Dietary group	Blood Vit. A µ gm. per cent.	Liver Vit. A µ gm. per liver	Worms found at autopsy: No. in intestine	Worms found at autopsy: Mean per cent. infection	Worms found at autopsy: In one lung
I.	*Diet I*					
	a. (– Vit. A)*	4.8	5.5	2013.33‡	87.53	
	b. (+ Vit. A)*	29.3	215.0	1656.50	72.01	
	Diet II					
	a. (– Vit. A)*	6.3	3.4	2201.25§	95.77	
	b. (+ Vit. A)*	21.8	271.5	1654.17	71.92	
II.	*Diet I*					
	a. (– Vit. A)†	6.3	7.8	159.40	7.97	27.00
	b. (+ Vit. A)†	27.5	205.56	12.60	0.63	72.20
	Diet II					
	a. (– Vit. A)*	5.6	8.4	204.33	10.22	23.8
	b. (+ Vit. A)*	22.7	310.98	13.83	0.69	59.5

* Represents mean values for 6 animals.
† Represents mean values for 5 animals.
‡ Represents mean values of 3 surviving animals.
§ Represents mean values of 4 surviving animals.

Experiment 3. The effect of vitamin A depletion upon the passive transfer of immunity. In order to test the influence of vitamin A deficiency upon the efficacy of plasma from "hyperimmunized" rats, each of the two groups of normal rats, the average weight of which was about 75 grams, was infected with approximately 600 larvae, and concurrently was administered an intraperitoneal dose (5 cc per 100 gms body weight) of plasma. When the animals were sacrificed 12 days later, post-mortem determinations revealed that animals that had been given plasma from "hyperimmunized" rats fed on vitamin A-deficient diets had more worms in the intestines (average 319.33 worms per rat) and fewer worms in the lungs; while reverse conditions existed in rats given plasma from "hyperimmunized" rats fed on adequate diet with supplementary vitamin A (average 168.6 worms per rat in intestines, with more worms in the lungs).

CONCLUSIONS

The above results indicate that the lack of vitamin A in the diet of the experimental animals lowers their resistance to primary infection, as well as subsequent reinfection, with *Nippostrongylus muris.* Furthermore, plasma derived from animals with low vitamin A levels affords no protection against this parasite in the way of positive transfer of immunity. In contrast, the rats fed on the same diet, plus vitamin A supplement, developed a marked resistance to infection with this nematode, such as has been described by Schwartz *et al.*;[5] in addition to protection rendered normal rats by plasma from "hyperimmunized" rats, as previously demonstrated by one of us.[6]

J. Y. C. WATT
WALTER R. C. GOLDEN
FRIDGEIR OLASON
GEORGE MLADINICH

DEPARTMENT OF PUBLIC HEALTH AND PREVENTIVE MEDICINE,
CORNELL UNIVERSITY MEDICAL COLLEGE

STUDIES REGARDING A GLUTAMINE-LIKE SUBSTANCE IN BLOOD AND SPINAL FLUID

IN view of the recent communication of Hamilton,[1] regarding the presence of a glutamine-like substance in the blood, it may be of interest to note some studies which we have been carrying on during the past few years regarding substances in the blood and spinal fluid which split off ammonia readily on mild acid hydrolysis.[2] We have found that spinal fluid, trichloracetic acid filtrates of blood plasma and serum, and ultrafiltrates of plasma and serum contain a substance which yields ammonia under the treatment indicated. It was also found that the rate of hydrolysis of this substance under a variety of conditions of acidity and temperature was practically identical with that of glutamine which we had prepared from beet root.[3] A quantitative method based upon those findings was developed which has been used up to date in a study of a rather large amount of clinical material and also in animal experiments.

The findings in our blood studies in man and rabbit are in keeping with those of Hamilton,[1] namely, that the amount of ammonia liberated is equivalent approximately to from 5 to 10 mg of glutamine per 100 cc of plasma or serum. It has also been found that spinal fluid contains similar amounts of this substance. This together with the studies with ultrafiltrates we believe is added evidence that the findings for blood filtrates are not due to artefacts resulting from its chemical treatment. Our method also rules out the possible presence of any appreciable amount of asparagine in the material studied.

It has been found further that insulin hypoglycemia and also the administration of glucose reduces the

[5] B. Schwartz, J. E. Alicata, J. T. Lucker, *Jour. Wash. Acad. Sci.*, 21: 259, 1931.
[6] J. Y. C. Watt, Abstract of Doctor's Thesis, Cornell University Press, 1942.
[1] P. Hamilton, *Jour. Biol. Chem.*, 145: 711, 1942.
[2] M. M. Harris, Tenth Annual Report of the Director of the New York State Psychiatric Inst. and Hosp., p. 41, 1940.
[3] H. B. Vickery, G. W. Pucher, H. E. Clark, *Jour. Biol. Chem.*, 109: 39, 1935; *Biochem. Jour.*, 29: 2710, 1935.

level of this substance in the blood, the effect of the former being more marked. The sparing action on protein metabolism by these factors is of special interest in this connection.

These findings support the suggestion which we made in a previous publication,[4] namely, that the depression of the level of the amino acids in the blood during insulin hypoglycemia may be due in part to its effect upon some point in the mechanism of the enzymatic activity of glutaminase.

The administration of certain amino acids such as (dl) α-alanine increased the level of this substance in the blood. Glycine, on the other hand, produced no effect in some animals and a variable increase in others. The reason for this variability is not clear at present but may be of importance regarding the question as to whether glycine undergoes deamination. Other amino acids are being investigated.

The findings of Krebs[5] that brain, liver, kidney and retina are rich in glutaminase activity and also the work of McIlwain[6] in which he isolated glutamine from horse meat lend added support to the probability that the glutamine-like substance is glutamine.

Our studies are still in progress and some of the clinical and experimental data will soon be published.[7]

I am indebted to Roslyn T. Roth and Ruth S. Harris for their technical assistance.

Meyer M. Harris

Department of Internal Medicine,
New York State Psychiatric Institute
and Hospital

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PROMISING NEW SOIL AMENDMENT AND DISINFECTANT[1]

The serious crop losses suffered by growers as a result of injuries to plants by specific organisms in the soil indicate the need for a low-cost disinfectant which could be applied as an insurance measure in soils suspected of harboring such organisms. This need is particularly great where prediction of damage can not be made prior to planting or in areas where the incidence of such damage is spotty or where the economics of the crop preclude the use of expensive materials.

Preliminary results obtained by the use of a mixture of 1–3 dichloropropylene and 1–2 dichloropropane indicate that this material promises to fill this need. The material used in these experiments was obtained from the Shell Development Company at Emeryville, California, from whom it is available in two grades, one an approximately 50–50 mixture of the two compounds, and the other a crude form containing about 75 per cent. of the mixture, the balance being impurities of various kinds. It is low-priced compared with any competing product and, compared with chloropicrin, is extremely simple to handle. It is shipped in ordinary 55-gallon drums and can be handled without the use of a gas mask in the open air. In common with similar compounds, breathing of the fumes should be avoided and the precaution taken of promptly washing off with water any of the mixture which might be spilled on the hands or skin. No other commercial use for the material has thus far been found and no priorities are currently involved in its manufacture.

Tests with rapidly maturing vegetable crops grown in soil heavily infested with the root-knot nematode (*Heterodera marioni*) have shown that a very real measure of control has been obtained, not only in the plot which was covered with asphalt impregnated paper used as a mulch paper before treatment, but also in a parallel plot which received no seal of any kind either prior to or after the treatment. This is particularly important when the needs of the small grower are considered. In these tests, injections were made at intervals 1 foot apart, the amount per acre being approximately 200 pounds. Furthermore, in these tests, the crude form of the mixture was used. This crude form contains some impurities, but its manufacture involves fewer processes and it is therefore cheaper.

Experiments in pineapple fields have been conducted since the spring of 1940. In these experiments, a dosage of 150 pounds of the mixture in pure form per acre was used and injections were made through the mulch paper. The results thus far have shown that in all the locations in which the treatments were applied, definite and favorable response in growth has been obtained. The results are particularly striking in an area where a complex, including at least *Anomala* beetle larvae (*A. orientalis*), nematodes and pythiaceous fungi, has resulted in serious plant failure. In all cases, the results can be compared with those from equivalent applications of chloropicrin and, without exception, the new treatment is at least equal to that material in its benefits.

[4] M. M. Harris, J. R. Blalock and W. A. Horwitz, *Arch. Neurol. and Psychiat.*, 40: 116, 1938.

[5] H. A. Krebs, *Biochem. Jour.*, 29: 1951, 1935.

[6] H. McIlwain, P. Fildes, G. P. Gladstone, and B. C. J. G. Knight, *Biochem. Jour.*, 33: 223, 1939.

[7] M. M. Harris, *Jour. Clin. Investigation* (in press). July, 1943.

[1] Published with the approval of the acting director as Technical Paper No. 145 of the Pineapple Research Institute, University of Hawaii.

Results in pineapple fields did not make themselves evident for over a year after treatment, indicating that the soil disinfection, apart from its immediate effect in reducing populations of harmful organisms, had also affected the soil complex in such a way as to permit the plant to gradually show increasing improvement over the untreated checks. This was in direct contrast to the results with chloropicrin which, as usual, manifested themselves earlier with a dark-green growth typical of pineapple plants grown in chloropicrin-treated soil.

It is probaly true that the broad function of treatments such as these is to amend the biological complex of the soil so that the end result expressed in terms of plant health and plant yield is favorable. Biological complexes in the soil may be radically changed through the elimination of some specific organism and the suppression or stimulation of others. Such changes may be as significant for the end result as the initial effect on the specific organism, particularly if the crop in question is slow in maturing.

Much experimental work remains to be done on the effect of the treatment on specific organisms, the range of practical dosages for varying soils and weather conditions and the possibilities of treating soil around growing plants. When the pineapple plant is used as the test plant in such experiments the final results are slow to accrue, but since the material (called D–D mixture for short) has such great potential usefulness for other more rapidly maturing crops in a great many agricultural areas, it seems advisable to present the preliminary results at this time so that these potentialities can be fully explored.

WALTER CARTER

PINEAPPLE RESEARCH INSTITUTE,
HONOLULU, HAWAII

A SIMPLE BIRD HOLDER FOR USE IN AVIAN MALARIA STUDIES

WE wish to describe briefly here the canary holder which has superseded in our laboratory the one described a few years ago (SCIENCE, 88: 114, 1938). The new holder (see sketch), which has the great advantage of not injuring a bird, consists essentially of a thin brass tube of a size that a canary can be snugly fitted into, altered as indicated below.

In what is to be the hind end a notch is made about five eighth inch wide and one quarter inch deep with holes so placed in each corner that a straight wire can be passed through both of them. Just above each of these holes a slight perpendicular groove is filed on the outer surface of the tube to serve as a lock for the handle of the key which is made of half-hard brass wire.

Thin galvanized iron sheet metal is soldered across the other end and a portion bent forward to form the headrest.

The bird is inserted slowly into the holder until its head protrudes from the opening in the front end and it is then held in position by inserting the key above

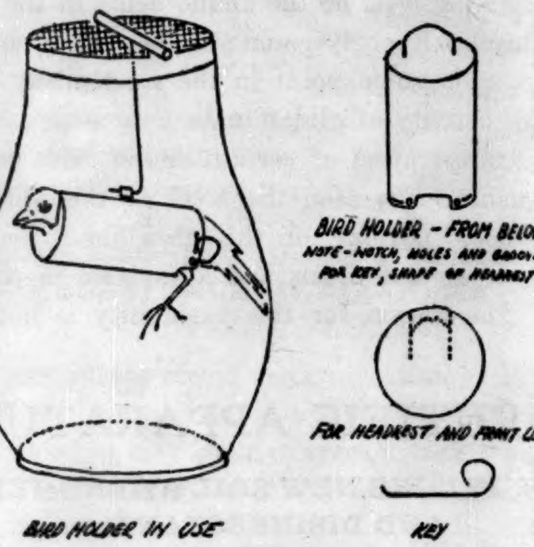

FIG. 1.

the legs dangling from the hind end and locking it in place. The holder and its contained bird are then suspended in a globe with mosquitoes.

ROBERT K. OTA
HARRY BECKMAN

MARQUETTE UNIVERSITY SCHOOL
OF MEDICINE

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DULL, CHARLES E. and MICHAEL N. IDELSON. *Fundamentals of Electricity.* Illustrated. Pp. xx + 456. Henry Holt and Company. $2.00.

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BARKER, ROGER G., JACOB S. KOUNIN and HERBERT F. WRIGHT. *Child Behavior and Development.* Illustrated. Pp. viii + 652. McGraw-Hill Book Company. $4.00.

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